CLAIMS

1. A process for the gas-phase catalytic polymerization of olefins carried out in a plurality of interconnected polymerization zones, the process comprising feeding one or more monomers to said polymerization zones in the presence of a catalyst under reaction conditions and collecting the polymer product from said polymerization zones, in which process the polymer particles grow within a first polymerization zone where a fluidized bed is formed, at least a part of said polymer particles leave said first polymerization zone to enter a second polymerization zone through which they flow downward, leave said second polymerization zone and enter a third polymerization zone through which they flow upward under fast fluidization or transport conditions, leave said third polymerization zone and are reintroduced into the first polymerization zone, thus establishing a circulation of polymer between the different polymerization zones.
2. The process according to claim 1, wherein the inlet of said second polymerization zone is placed in the upper region of said first polymerization zone below the upper limit of said fluidized bed.
3. The process according to claims 1-2, wherein in said second polymerization zone the polymer particles flow downward in a densified form under the action of gravity.
4. The process according to claims 2-3, wherein said second polymerization zone is set up inside a vertical pipe which is coaxial with said first polymerization zone.
5. The process according to claims 1-3, wherein said second polymerization zone is set up into a pipe running outside the first polymerization zone, the inlet of said pipe being directly connected to the upper region of said first polymerization zone.
6. The process according to claims 1-3, wherein said second polymerization zone is set up into an annular chamber formed between the walls of a fluidized bed reactor and a vessel placed inside and coaxial with said fluidized bed reactor.
7. The process according to claims 1-6, wherein the third polymerization zone is set up into a pipe running outside said first polymerization zone.
8. The process according to claims 1-7, wherein the polymer particles leaving said third polymerization zone are reintroduced into said first polymerization zone at a point situated above the upper limit of said fluidized bed.
9. The process according to claims 1-8, wherein fast fluidization conditions are established in said third polymerization zone by feeding a gas through a line placed at the inlet of said third polymerization zone.

10. The process according to claim 9, wherein in said third polymerization zone the gas superficial velocity is comprised between 0.5 and 15 m/s.
11. The process according to claims 1-10, wherein a part of polymer particles growing inside said fluidized bed enters directly the third polymerization zone through a pipe connecting the lower region of said fluidized bed to said third polymerization zone.
12. The process according to claims 1-11, wherein one or more α-olefins CH_2=CHR, where R is hydrogen or a hydrocarbon radical having 1-12 carbon atoms, are polymerized.
13. The process according to claims 1-12, wherein the gas mixture present in said first polymerization zone is partially prevented from entering said second polymerization zone by introducing a gas and/or liquid mixture of composition different from the mixture present in the first polymerization zone through one or more introduction lines placed in the upper part of said second polymerization zone.
14. The process according to claim 13, wherein the introduction of said gas and/or liquid mixture of different composition establishes a net gas flow upward at the upper limit of the second polymerization zone.
15. The process according to claims 13-14, wherein the upper part of said second polymerization zone acts as a stripping column to further remove the volatile components from the gas stream flowing downward along said second polymerization zone.
16. The process according to claim 13, wherein a liquid mixture is introduced in the upper part of said second polymerization zone.
17. The process according to claim 16, wherein the hydrogen content of said liquid mixture decreases as it goes down to the lower sections of said second polymerization zone.
18. The process according to claims 1-17, wherein the gas mixture present in the second polymerization zone is partially prevented from entering the third polymerization zone by introducing a gas and/or liquid mixture of composition different from the mixture present in the second polymerization zone, through one or more introduction lines placed at the bottom of said second polymerization zone and/or at the inlet of said third polymerization zone.
19. An apparatus for the gas-phase polymerization of olefins comprising:
    - a fluidized bed reactor having a reaction chamber, a distribution plate placed below said reaction chamber, a velocity reduction zone placed above said reaction chamber,

- a vertical pipe running inside said reaction chamber, a first end of said vertical pipe protruding from the bottom of the fluidized bed reactor, the other end of said vertical pipe extending up to the higher region of the reaction chamber,
- one or more pipes running outside said reactor chamber and connecting the bottom of said vertical pipe to the fluidized bed reactor at a point in the upper portion of said reaction chamber and below said velocity reduction zone.

20. The apparatus according to claim 19, wherein said vertical pipe is equipped at its top portion with a line for feeding gas or liquid.

21. The apparatus according to claim 19, wherein said vertical pipe is equipped at its bottom portion with a polymer discharge line and with a line for introducing a gas mixture coming from the recycle line.

22. An apparatus for the gas-phase polymerization of olefins comprising:
- a fluidized bed reactor having a reaction chamber, a distribution plate placed below said reactor chamber, a velocity reduction zone placed above said reactor chamber,
- one or more pipes running outside the fluidized bed reactor and extending downward from an opening in the higher region of the reaction chamber,
- one or more pipes connecting the bottom of said downward extending pipes to the fluidized bed reactor at a point in the upper portion of said reaction chamber and below said velocity reduction zone.

23. The apparatus according to claim 22, wherein said one or more pipes form a loop outside and around the fluidized bed reactor.

24. The apparatus according to claim 23, wherein the inlet portion of said loop is equipped with a line for feeding a gas or liquid mixture.

25. An apparatus for the gas-phase polymerization of olefins comprising:
- a fluidized bed reactor having a reaction chamber, a distribution plate placed below said reaction chamber, a velocity reduction zone placed above said reaction chamber, a vessel placed inside the fluidized bed reactor, coaxially to it, and replicating its shape so to form an annular chamber between its walls and those of the fluidized bed reactor,

  wherein the upper end of said vessel extends up to a point in the upper portion of said reaction chamber while the bottom end extends up to a point situated below said velocity reduction zone,
- one or more pipes running outside the fluidized bed reactor, said pipes connecting the

bottom of said annular chamber to the fluidized bed reactor at a point in the upper portion of said reaction chamber and below said velocity reduction zone.

26. The apparatus according to claim 25, wherein the annular chamber is equipped at its top portion with one or more lines for feeding a gas and/or liquid mixture.

27. The apparatus according to claim 25, wherein the annular chamber is equipped at its bottom portion with one or more lines for introducing a gas and/or liquid mixture coming from the recycle line.